A TOPOGRAPHIC FEATURE OF THE HANGING VALLEYS OF THE YOSEMITE.

THE larger hanging valleys around the Yosemite valley have topographic features in common that are interesting in themselves, and they likewise afford some evidence in regard to the comparative cutting powers of ice and water.

When formerly I used to look up from the valley below at the Upper Yosemite fall, I always wondered what kind of topography there could be up on top to cause Yosemite Creek to come over the rim of the valley at an elevation much higher than the gorge just east of it—the gorge through which the trail to Eagle Peak passes. A glance at Fig. 4 will show what is meant. That topography was explained during a recent visit to the Yosemite, when I had an opportunity to see the valleys above some of the falls.

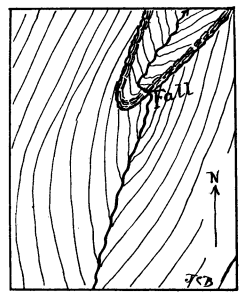

FIG. 1.—Sketch showing how Illilouette Fall enters the gorge at the side.

The Illilouette fall is not quite at the head of the canyon; the canyon passes by or overlaps the creek so that the creek enters the canyon on its east side, as shown in the accompanying sketch. (Fig. 1.)

At the Nevada fall this overlapping of the canyon below by the stream above the fall is still more marked, although, owing to the choking up of the head of the gorge, it does not attract one's attention so promptly. The trail leading to the top of the Nevada fall passes up through this side gorge.

At the Vernal fall again the gorge below extends up past the fall, though the overlap is only short in this case.

The explanation seems to be the same for each of these forms. Take first the Illilouette fall: the South Canyon Creek, or Illilouette Creek, which forms the Illilouette fall drains a large area, especially on the south and west side of the stream. Toward the close of the glacial epoch, when the main Yosemite

valley was free from ice, or at least free enough to allow the water flowing in from the side valleys to fall over precipices, the waters from the melting snows and ice over the drainage basin of Illilouette Creek flowed down along the west side of the glacier that still filled the Illilouette valley above the fall. When this water reached the canyon, it found the bottom of the upper valley full of ice, and it was thus obliged to fall into the canyon —not from the bottom of the valley trough, but at the west side of the glacier. (See Fig. 2.) This stream cut the head of the gorge back past the lower end of the axis of the upper valley. When the ice disappeared, the water returned to the real bottom of the valley, and was then obliged to fall over the side of the gorge instead of at its upper end.

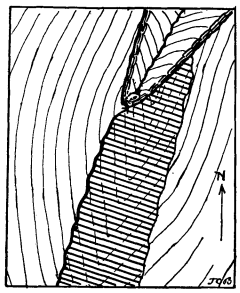

FIG. 2.—Sketch to show how the glacier above Illilouette Fall (shaded area) crowded the stream to the west and caused it to cut a gorge that overlaps the axis of the upper valley.

The topography of the Nevada fall is even more striking than that of the Illilouette fall. The gorge that overlaps the stream and site of the present fall is so long and large that the trail leading to the upper valley and to Clouds Rest passes through it. It is much choked up with loose débris, while there are large quantities of waterworn material exposed at the upper lip of the gorge.

Ice marks are abundant at the head of the Nevada fall, though most of them have been obliterated from exposed surfaces.

The explanation of this overlapping gorge is the same as that for the Illilouette fall: towards the close of the glacial epoch, but while the Little Yosemite —the valley just above the fall— was still filled with ice, the water flowing down the north side of the glacier there plunged into the lower gorge and gradually cut its way back by the side of the glacier. When in time the ice disappeared from the edge of the bluff, the stream abandoned its old place beside the glacier and flowed over the cliff at the site of the present Nevada fall. (Fig. 3.)

The overlapping gorge of the Vernal fall is not so long as that of the Nevada fall, and for some reason it is on the south side of the stream.

These explanations also show why the Upper Yosemite fall is not in the deep gorge that cuts back into the north wall of the valley on the west side of the stream. The stream follows the axis of the original valley; the gorge just west of it was cut toward the close of the glacial epoch by a stream that was crowded to one side by the great glacier that filled the main

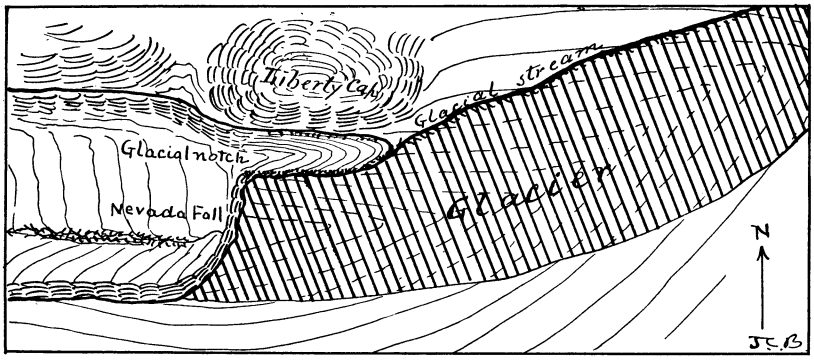

FIG. 3.—Sketch to show how the stream above Nevada Fall was crowded northward by the ice (shaded area), and how it cut a gorge past the present position of Nevada Fall.

valley. For the glacier that came down Yosemite Creek was fully ten miles long above the site of the present Yosemite fall.

It is quite probable that other notches in the canyon walls near these high falls from the hanging valleys have had a similar origin.

In each of these cases it is evident that the cutting done by the stream was much more rapid than that done by the ice, for in every instance the stream gained upon the glacier until the two channels overlapped each other.

If the explanation here offered for these peculiar forms be correct, it may well be asked why there is no such feature at the Bridal Veil fall, for this last apparently has no such overlapping canyon, while its position and history is otherwise similar to those of the other falls around the Yosemite valley. On the west side

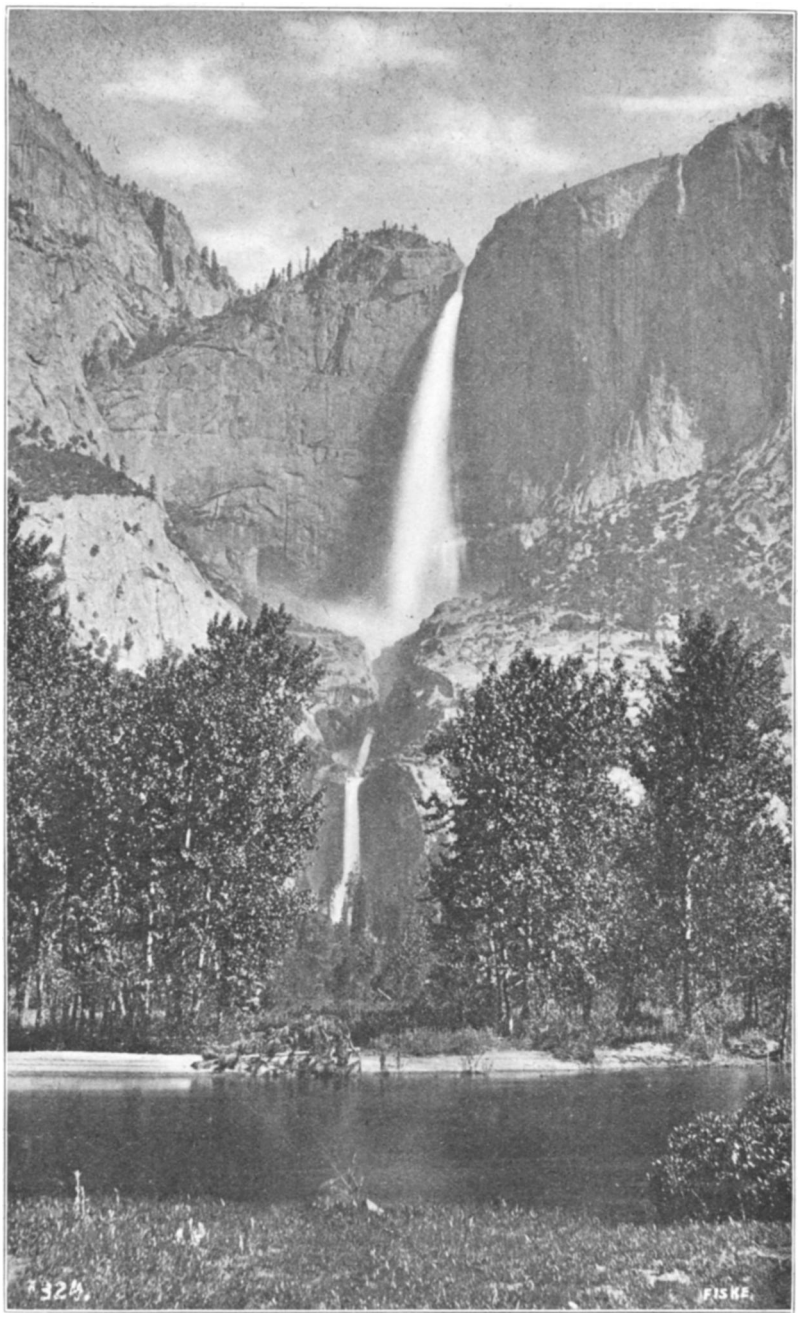

FIG. 4.— The Yosemite falls seen from the valley below. When the ice along the west side of the glacier filled the upper valley the water came down and cut the deep notch seen on the left of the upper fall.

of the Bridal Veil fall is a notch that may have been formed in the fashion here indicated; but if it was made in this manner, it does not at present overlap the end of the valley trough where the fall is. Seen from the Coulterville road across the valley to the north, it looks as though a stream on the east side of the Bridal Veil glacier may have fallen through the deep notch that opens on the side of the valley toward Cathedral Rock. I cannot say positively that this happened, however, for I did not go above the fall to look for the evidence.

It is worthy of note that in both instances where the falls occur in pairs, namely at the Yosemite (upper and lower falls) and at the Nevada and Vernal falls, narrow subglacial channels are cut between. This was to have been expected. When the ice broke at the upper fall, the water flowing from above entered the crevasses below and flowed as subglacial streams at least as far as the lower falls.

Since the glacial epoch the rocks have exfoliated and disintegrated so rapidly that ice marks are still visible at less than a dozen places on the exposed surfaces of the Yosemite valley walls. At the top of Vernal falls a dark inclusion in the flat granite surface preserves the ice marks perfectly, but the surrounding rock has disintegrated to a depth of fully two inches since the melting ice uncovered the spot. Similar instances may be seen above the Nevada fall and about Inspiration Point on the road from the valley to Wawona. Everywhere the exposed surfaces are rapidly going to pieces. The same agencies must have hastened the formation of the valley before the glacial epoch.

The evidence of the falls at the mouths of the hanging valleys shows that the wearing done by the ice was trivial as compared with the wearing done by the glacial streams. The subglacial streams also cut channels beneath the ice a great deal faster than the ice alone cuts the broader floors over which it moved.

Considered alone, these canyons overlapping the streams that enter them from above afford evidence that the period since the glacial epoch has been very short as compared with the length of the glacial epoch itself.

I venture to add that I quite agree with Mr. Turner's views of

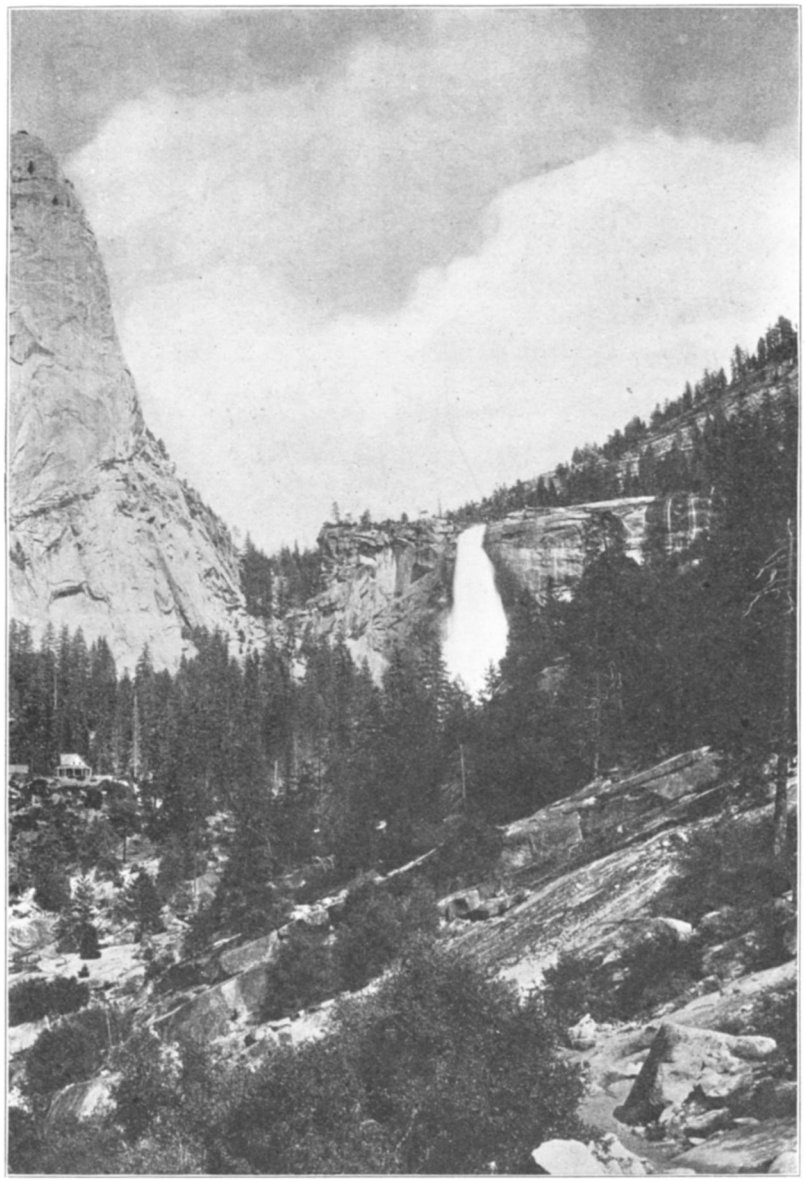

FIG. 5.— Nevada Fall, and the glacial notch just north of it, through which the trail passes.

the origin of the Yosemite valley itself (by stream erosion before the glacial epoch) and of the influence of the nature of the rock and of rock joints upon the topography.[1]

Unfortunately the large and constantly increasing number of visitors to the valley are misled by so excellent a guide as Baedeker's *U. S. Handbook*, edition of 1899, p. 509, which still gives as the accepted explanation of the origin of the Yosemite valley the fault theory advanced by Whitney many years ago. It is very desirable that the U. S. Geological Survey should bring out as soon as possible Mr. Turner's Yosemite folio and set the question at rest in the popular mind.

J. C. BRANNER.

[1] H. W. TURNER, "The Pleistocene Geology of the South Central Sierra Nevada, with Especial Reference to the Origin of Yosemite Valley," *Proc. Calif. Acad. Sci.*, 3d ser., Vol. I, pp. 262-321.